

AMENDMENT

Statement of the Claims

1. (previously presented) An optical apparatus for investigating a fluid stream,
comprising:

an optical probe having a distal end and a longitudinal axis, said distal end of said
optical probe comprises a tapered tip having a substantially cubical corner defined by
three planes substantially perpendicular to each other and not parallel to a plane including
said longitudinal axis.
2. (previously presented) An optical apparatus according to claim 1, wherein:

a diagonal of said cubical corner is aligned with a longitudinal axis of said optical
probe.
3. (original) An optical apparatus according to claim 1, wherein:

an incident angle of light at each of said three planes is $54.73^{\circ} \pm 1^{\circ}$.
4. (previously presented) An optical apparatus according to claim 1, wherein:

said optical probe terminates at a sharp tip where said three planes meet.
5. (previously presented) An optical apparatus according to claim 1, wherein:

said tapered tip of said optical probe terminates at a rounded corner.

6. (previously presented) An optical apparatus according to claim 5, wherein:

said three planes define three lines where respective sets of two of said three planes meet, and said optical probe is rounded at each of said three lines.

7. (previously presented) An optical apparatus according to claim 1, wherein:

said optical probe has a base adjacent cubical corner, said base tapering in diameter from a larger to a smaller diameter as said probe extends distally towards said cubical corner.

8. (original) An optical apparatus according to claim 7, wherein:

said taper is less than 10° .

9. (original) An optical apparatus according to claim 7, wherein:

said taper is at most 5° .

10. (previously presented) An optical apparatus according to claim 1, wherein:

said optical probe has a diameter of between 0.2 mm and 0.4 mm.

11. (currently amended) An optical apparatus for investigating a fluid stream,
comprising:

an optical probe comprising a continuous optical fiber having a first portion of substantially constant diameter and a tip having a distal end, said distal end of said optical probe comprises formed as a substantially uniform cone having a conical face angled at $45^{\circ} \pm 2^{\circ}$ relative to a longitudinal axis, said substantially uniform cone extending to said first portion.

12. (currently amended) An optical apparatus according to claim 11, wherein:

said ~~optical probe tip~~ terminates at a sharp tip point.

13. (currently amended) An optical apparatus according to claim 11, wherein:

said ~~optical probe tip~~ terminates at a symmetrically rounded tip portion, said rounded tip having a diameter at most twenty-five percent of a width of said optical probe at a base adjacent said cone.

14. (currently amended) An optical apparatus according to claim 11, wherein:

said first portion of said optical fiber of said optical probe ~~has~~ includes a base adjacent said cone, said base tapering in diameter from a larger to a smaller diameter as said probe extends distally towards said cone.

15. (original) An optical apparatus according to claim 14, wherein:

said taper is less than 10° .

16. (original) An optical apparatus according to claim 14, wherein:

said taper is at most 5°.

17. (previously presented) An optical apparatus according to claim 11, wherein:

said optical probe has a diameter of between 0.2 mm and 0.4 mm.

18. (currently amended) An optical apparatus for investigating a fluid stream,

comprising:

an optical probe comprising an optical fiber having a distal end, said distal end of said optical fiber comprises ~~either a paraboloid or~~ a hemisphere.

19. (canceled)

20. (currently amended) An optical apparatus according to claim 18, wherein:

said optical fiber has a base adjacent said ~~paraboloid or~~ hemisphere, said base tapering in diameter from a larger to a smaller diameter as said fiber extends distally towards said ~~paraboloid or~~ hemisphere.

21. (original) An optical apparatus according to claim 20, wherein:

said taper is less than 10°.

22. (currently amended) An optical apparatus for investigating a fluid stream, comprising:

an optical probe having an ~~at least one~~ optical fiber, said ~~one~~ optical fiber having a distal end and a longitudinal axis, said distal end of said ~~one~~ optical fiber comprising a tapered tip having a substantially cubical corner defined by three planes substantially perpendicular to each other and not parallel to a plane including said longitudinal axis.

23. (currently amended) An optical apparatus for investigating a fluid stream flowing in a well, comprising:

a) a tool having an elongate body suspended in the well;
b) a light source; and
c) a plurality of optical probes coupled to said elongate body and to said light source, said plurality of optical probes including at least one probe comprising an optical fiber having a longitudinal axis and a distal end with a tapered tip arranged as either

(i) a substantially cubical corner defined by three planes substantially perpendicular to each other and not parallel to a plane including said longitudinal axis,

~~(ii) a paraboloid;~~ or

~~(iii)~~ (ii) a hemisphere.

24. (currently amended) An optical apparatus ~~according to claim 23, wherein:~~ for investigating a fluid stream flowing in a well, comprising:

- a) a tool having an elongate body suspended in the well;
- b) a light source; and
- c) a plurality of optical probes coupled to said elongate body and to said light source
including

~~said plurality of optical probes includes~~ a first probe comprising an optical fiber having a distal end arranged as either a substantially cubical corner defined by three planes substantially perpendicular to each other and not parallel to a plane including said longitudinal axis, or a substantially uniform cone having a face angled at $45^\circ \pm 2^\circ$ relative to a longitudinal axis, and a second probe comprising an optical fiber having a distal end arranged as a paraboloid or a hemisphere.

25. (currently amended) An optical well logging apparatus for investigating a fluid stream flowing in a well, comprising:

- a) a tool having an elongate body suspended in the well;
- b) a light source; and
- c) a plurality of optical probes coupled to said elongate body and to said light source, said plurality of optical probes including a first probe comprising an optical fiber having a distal end arranged to provide a numerical aperture of below 0.3 and a second probe not in physical contact with said first probe and comprising an optical fiber having a distal end arranged to provide a numerical aperture of above 0.8.